Chapter I

Introduction

Generality

Traditionally, hot rolling of deep drawing qualities (DDQ), ultra low carbon (ULC) or interstitial free (IF) steels is carried out in the austenitic range, with keeping the finishing temperature above the austenite-ferrite phase transformation temperature. However, Herman and Leroy [1] stated that for hot rolled strips with thickness less than 1.8 mm austenitic rolling can not be performed successfully due to the temperature drop in the last stands. This would entail partial rolling in the dual-phase range austenite-ferrite. "Intercritical rolling" in the dual-phase range is difficult to control dimension and entails heterogeneous product quality.

To produce hot strip with thin gauges less than 1.8 mm and requested mechanical properties, rolling in the ferritic range has been investigated. Herman and Leroy [1] pointed out that the rolling loads in the ferritic range are similar to those in the austenitic range. By this, it makes possible to perform ferritic rolling on existing mills. The technique of ferritic rolling has recently

be brought in practical operation entailed with decreasing energy consumption, less work roll wear as well as improvement of mechanical properties of the products. Additional wider strip formats with thinner gauges may be produced.

There are many studies concerning the flow behaviour of steels rolled in the austenitic range. In addition, several mathematical models have been proposed to predict the change of flow stress and the microstructural evolution during forming. However, only few studies have concentrated on the behaviour of steels rolled in the ferritic range. Therefore a thorough understanding of the effects of deformation parameter on the flow behaviour during deformation in the ferritic range requires laboratory simulation.

Objectives

The objectives of this study were:

1. To investigate the differences of softening behaviour of DDQ steel during deformations in the austenitic and the ferritic range

2. To investigate the influence of austenitizing condition, deformation temperature and strain rate on softening behaviour

Scope

The goal of this work is to investigate the differences of softening behaviour of DDQ steel during deformations in austenitic, ferritic and dual-

phase range using hot compression tests. The investigated steel is an aluminium killed steel, St 15. In this work two different austenitizing conditions were chosen. After high temperature austenitizing at 1250 °C for 10 minutes a coarse austenite structure with a mean grain size of about 370 μm was achieved. A fine grain size of about 35 μm was achieved after austenitizing at 1000 °C for 5 minutes. By this, effect of initial grain size on the softening behaviour can be investigated. The samples were cooled to deformation temperature with nitrogen gas after austenitizing. Various deformation temperatures between 700 °C and 1250 °C (or 700 °C and 1000 °C) were chosen with steps of 50 K or 25 K. The strain rates were 0.01, 0.1, 1 and 10/s to investigate the influence of strain rate on the softening behaviour. During the hot compression test, all process parameters, e.g., force, upset distance, temperature and time were recorded. After deformation the samples were quenched to room temperature with nitrogen gas. The recorded data is used to calculate stress-strain curves. In addition metallographic examination and grain size measurement of the deformed samples were done.

Expected Benefits

The expected benefits from this work are as follows:

1. To know the effects of deformation parameter on the flow behaviour, e.g., changing ratio of deformation load when changing deformation parameter such as deformation temperature and strain rate

2. To be a fundamental data for investigating low temperature rolling